ECE 100 - ITP
Lecture 9

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Questions?

❑ Post-lab 8 Milestone due this week (last of the lab reports)

❑ Round 2a Competition - this week in lab (1.5 hours to prepare)

❑ Round 2b Competition - next week in lab

❑ Round 2b Extra Credit for all teams
  ➢ 0.2 pt * Teamwork Score for each puck pushed into scoring position during Round Robin, even if the other team pushes it out of scoring position

❑ Final Design Portfolio due Mon, Dec 3 at 1:30 PM in SH 118

Round 2 - Performance Tuning

❑ Observations
  ➢ Fragile robots, exquisite claws, unreliable touch bumpers
  ➢ Code: lots of complicated code (hard to debug!); lots of untested code; lots of code written in lab; lots of time wasted

❑ Post-lab 8: Performance Tuning
  ➢ Construction/Implementation - Discuss modifications to hardware & software
  ➢ Analysis & Testing
    ❖ Did the robot push two pucks into scoring position? Was it reliable? Why/why not?
    ❖ Were you able to push three pucks into scoring position reliably? Why or why not?
  ➢ Future Work / New Optimum Solution
    ❖ Need new optimum solution and perhaps an alternative solution (implemented in IC) and corresponding flowcharts for pushing all three pucks into scoring position.

❑ Lab 9: Round 2a Competition
  ➢ Code should be able to push all three pucks into scoring position.

Lab Observations

❑ Need to prepare outside of lab.
  ➢ Choose strategy
  ➢ Distribute tasks
  ➢ Code: compile, check syntax, debug
  ➢ Plan physical robot modifications (keep it simple)
❑ Need to work as a team in lab.
  ➢ All group members should have some responsibility
  ➢ All group members should understand the code
  ➢ Open communication is critical
❑ Need to observe and analyze in lab.
  ➢ Document your design modifications
  ➢ Generate performance statistics based on trials
  ➢ Debugging: Test all assumptions, even the obvious ones; find out what went wrong by testing subsections of code
  ➢ Debugging: Insert "ao(); sleep(5.0);" at the beginning of each of the states
  ➢ Build simple diagnostics code to test analog/digital ports, motor power, etc.

State Machine

❑ One main event loop: while (timer() < 90)
- ➢ Create a series of "if-then-else" statements
  - ❖ if (conditional) {
       <statements>
     } else {
       if (conditional) {
         <statements>
       } else {
         <statements>
       }
     }
- ➢ Check the current state and a transition condition
  - ❖ If true, modify motors (if necessary), change state
  - ❖ If false, go to the next state check

❑ Related issues
- ➢ Use "seconds()" function to implement global timers
- ➢ Avoid long "sleep" times - drift, sensor blackout
- ➢ Avoid nested "while" loops

Final Design Portfolio - Due at 1:30 PM on Mon, Dec 3

❑ The body will follow the Design Portfolio structure, including

- ➢ Problem Statement: concise, precise, complete sentences.
- ➢ Research/Investigation: Present a theory for getting the job done.
- ➢ Alternative Solutions: List the strategies that you actually developed in IC.
- ➢ Optimal Solution: What? Why? How (development plan)?
- ➢ Construction/Implementation: Explain your "mint shuffle" code. Describe any robot modifications.
- ➢ Analysis & Testing: Provide the results of your lab experimentation, including competition outcomes.
- ➢ Final Evaluation/Conclusion: Problems? Adequate Solution? Future Work; Justify additional funding/support.

Final Design Portfolio - Point Breakdown

❑ Point breakdown (total of 120 points worth 20% of your final grade)

❑ The following sections are 10 points each:
  ➢ PS, R/I, AS, OS, C/I, AT, FE, Appendix (IC Code)

❑ The executive summary is worth 30 points.

❑ The remaining items will be worth 10 points in total (approx. 2 points each).
  ➢ Cover, Table of Contents, List of Figures, List of Tables, Acknowledgements, References

Physical Layout of Portfolio

❑ Bind your portfolio (clear plastic folder or 3-ring binder).
  ➢ Do NOT put each sheet of paper in its own plastic sleeve!
❑ Cover Page: Who, What, Where (ECE 100-X), When (due date)
❑ Table of Contents (reference the 13 sections below)
❑ List of Figures (list of diagrams that appear in body of report)
❑ List of Tables (list of tables that appear in body of report)
❑ Acknowledgements (group members, TA, etc.)
❑ Executive Summary (one page max)
❑ Body (PS, R/I, AS, OS, C/I, AT, FE)
❑ Appendix (IC code)
❑ References

Formatting and Max # of Pages

❑ The following items should be one page each:
  ➢ Cover, Table of Contents, List of Figures, List of Tables, Acknowledgements, Executive Summary, References

❑ The body of the report should contain the relevant body section headings and should flow continuously.
  ➢ Do not insert page breaks before each body section.

❑ Line spacing should be no more than 1.5; single is fine, but make sure it is easy to read.

❑ The font size should be no smaller than 10 and no larger than 12.
  ➢ Twelve point font may not allow you to describe your design adequately.

❑ The Appendix (IC Code ONLY) should begin on a new page.
  ➢ Only your final solution code should appear in the Appendix.

❑ The document (excluding the IC Code Appendix and References) is limited to 20 pages. Each page must be numbered.

❑ The body of your portfolio is limited to 14 pages, once you subtract the first six pages from the 20 page limit.

List of Figures & List of Tables

❑ Your report must have at least two figures.
  ➢ Examples: pictures of your robot, flowcharts, diagrams

❑ Your report must have at least two tables
  ➢ Examples; results of competitions, matrix of alternative solutions with solutions appearing as rows/records and various attributes heading each column

❑ Add additional figures and tables that enhance reader comprehension. They can add punch to your report.

❑ The List of Figures should use a tabular format:
  Figure #: Descriptive Title of Figure .... p. #
  Figure #: Descriptive Title of Figure .... p. #

❑ The same format should be used for your List of Tables.
  ➢ Please choose figure/table titles that are descriptive so that your reader can jump to the specific information of interest.

Scope and Executive Summary

- ❑ Final Design Portfolio covers the entire course.
- ❑ Focus on customer need (as defined by you) by relating to Round 2 (Mint Shuffle), but be sure to include earlier work in Rounds 0 and 1.
  - ➢ Research/Investigation is a great place to cover earlier Rounds.

- ❑ Motivate management to provide additional funds for your project.
- ❑ You must provide real evidence of your progress to justify additional funds.
- ❑ Stick to the actual results obtained in the laboratory.
- ❑ Based on your achievements with your prototype, describe how your robot will meet the needs of your company's target market.

Problem Statement

- ❑ Must be complete sentences. Keep it short and to the point.
- ❑ Keep in mind that the Problem Statement should set the stage for everything else in your Final Report.
  - ➢ Example: Develop an autonomous robot prototype to .... (fill in the customer need)
- ❑ Your Problem Statement section should include four items:
  - ➢ Short statement of the overall problem (1-2 sentences max)
  - ➢ List of criteria that you used to judge your overall performance as well as your robot's performance in the various sub-problems
  - ➢ List of constraints that were imposed on all teams (not just Round 2 specs)
  - ➢ List of assumptions that you made during the project
  - ➢ Bullet point lists need not be complete sentences
  - ➢ Focus on a few of the most important items for the lists - no grocery lists
- ❑ Common assumption:
  - ➢ Infinite energy battery pack, but "state-of-charge" decreases over time, especially when the motors are used heavily

Research/Investigation

❑ Explain the theory behind the robot's behavior.
  ➢ In path following, the light sensors react to reflected ambient light focused by the sensor shields.
❑ Include your Round 0 and Round 1 competitions as key investigations into the capabilities of the touch sensors, light sensors, DC motors, controller board, Interactive C development environment, etc.
❑ Reference the textbook, class web site, and any other sources that you have used in your research.
❑ Cite your sources with numbers in square brackets (e.g., [1]) which refer to the citations in the References section at the end of your report.

Alternative Solutions

❑ In order to call it the "Alternative Solutions" section, there must be more than one proposed solution.
❑ There is no upper limit to the number of alternatives that you present, but be sure to describe them adequately.
❑ Give brief descriptions of your brainstorming outcomes.
❑ Explain the strategies with simple flowcharts inserted in the text, not in the Appendix.
❑ Briefly enumerate advantages/disadvantages.
❑ Your optimum solution should be included briefly in "alternatives".
  ➢ Then, under "Optimum Solution" you should describe your best idea in more detail.

Optimum Solution

❑ This depends on the criteria you chose in the Problem Statement.

❑ Keep in mind the list of "desirable characteristics" that we developed in a brainstorming session in lecture.

❑ Why is the algorithm optimal?

❑ What are its desirable characteristics?

❑ Describe your plan for implementing your optimum solution.

❑ Give a detailed description of your algorithm, but don't include your IC code. Consider the following methods for presenting the details (note: do not repeat overview from previous section):

    ➢ Pseudo-code describing the core features

    ➢ Additional flowchart illustrating core features

Construction/Implementation

❑ This section should explain your code and your robot.

❑ Focus on the implementation of your optimum solution.

    ➢ The key features should be directly related to your criteria.

    ➢ Each key feature should help your design solution achieve your goal.

    ➢ How did you build the robot or write the code to implement the feature?

❑ Reference the complete IC code in the Appendix.

❑ Show key segments of IC code (no pseudo-code).

❑ Point out the important features of code.

    ➢ Abstraction

    ➢ Global variables

    ➢ Configurable parameters

❑ Include one or two pictures of your final robot.

Analysis and Testing

❑ Describe your testing procedure.
❑ Provide figures explaining test procedures.
❑ Provide tables demonstrating performance.
❑ Present the results of Round 2.
❑ Discuss any iterative improvements
  ➢ What was wrong?
  ➢ How did you try to fix it?
  ➢ How well did your "improvement" work?
❑ Propose future improvements to solve any remaining problems.

Final Evaluation/Conclusion

❑ Restate objective.
❑ Briefly describe your key design features.
❑ Reiterate successes and benefits.
❑ Briefly explain future improvements.
❑ Evaluate your design with a critical eye.
❑ Motivate management to provide additional funds.

Appendix - IC Source Code

❑ Final solution only
❑ Comment headers should appear at the top of every source file.
  ➢ Overall purpose
  ➢ Tunable parameters
  ➢ Author(s)
  ➢ Date
❑ IC source should contain comments explaining significant code segments.

References/Bibliography

❑ The "References" page at the end of the Final Design Portfolio should contain all of your citations.
  ➢ Include the textbook, the class web site (if you've included any web site materials such as competition specifications), and any other print or online resources.
  ➢ Think of the References page as a page of footnote citations, often called endnote citations. It is similar to a bibliography, but the entries are numbered sequentially, rather than alphabetized.
❑ The References page should contain reference numbers in square brackets.
  ➢ The bracketed numbers should be used throughout your report to cite the original source of any reference material of which you were not the original author.
  ➢ Please use bracketed numbers rather than superscript numbers.
❑ Follow the CAC web site link to online resources for citation notes:
  ➢ Click on "CAC Writing Guides" under "Links" on the ECE 100 web site.
  ➢ Click on "Documentation Styles" then go to "Purdue Online Writing Lab". Use the format of the MLA "Works Cited" or the APA "Reference List".